

SCIENCE

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CHANGES IN COLOR OF HAIR AND FEATHERS.

THE question of change of color of the hair is an interesting one both from a physiological point of view and from the practical one of pathology. The physiological aspect embraces the question of how a change of color takes place, —whether in existing hairs, or produced by shedding of the hair and a new growth taking its place of a different color.

It has been doubted by good authority (Hebra and Kaposi) if the hair, after being once developed, can change except by a very gradual process. This doubt is based upon the theory that the hair has no vascular or nerve connection with the general system, and must therefore be independent of nervous or systemic influence. This position is, however, not tenable. The clinical evidence is positive that the hair does change color under systemic influences, sometimes gradually, and sometimes suddenly. We hear frequently of the hair turning white in a night from violent emotions, as fright, great grief, or great joy; and it has come to be a method of expressing extreme emotion to say, "It was enough to turn one's hair white." I say it is not an uncommon thing to see mention of such cases in popular literature, but well-authenticated cases are not so often found. It is recorded in history that the hair of Marie Antoinette and Mary Queen of Scots became white suddenly from the horrors to which they were subjected. Poets have not failed to avail themselves of the idea. Byron, in the "Prisoner of Chillon," says,—

"My hair is gray, but not with years;
Nor grew it white
In a single night,
As men's have grown from sudden fears."

A short time since, in conversation with an eminent microscopist and pathologist,¹ I asked how he would explain from the basis of minute anatomy the sudden change in color of the hair. He replied that he did not explain it; that he did not believe it happened; that the reported cases were not authenticated. He further said, that, from the structure of the hair and its relation to the skin, he considered it impossible.

Dubring (third edition) is authority for the statement that Hebra and Kaposi discredit sudden canities. There is nevertheless no doubt of the fact that such change does sometimes occur; and, to set the matter definitely at rest, I looked up the subject in the Library of the Surgeon-General's Office. The following are some of the references found:—

Dr. William P. Dewees² reports a case of puerperal con-

vulsions under his care. From 10 A. M. to 4 P. M. fifty ounces of blood were taken. Between the time of Dr. Dewees's visits, not more than an hour, the hair anterior to the coronal suture turned white. The next day it was less light, and in four or five days was nearly its natural color. He also mentions two cases of sudden blanching from fright.

Dr. Robert Fowler¹ reports the case of a girl sixteen years of age, apparently in good health, hair black, who found one morning in combing her hair that a strip the whole length of the back hair was white, starting from a surface about two inches square around the occipital protuberance. Two weeks later she had patches of *Ephelis* over the whole body.

In the *Canada Journal of Medical Science*, 1882, p. 113, is reported a case of sudden canities due to business worry. The microscope showed a great many air-vesicles both in the medullary substance and between the medullary and cortical substance.

Dr. Graves² says most authors are of the opinion that the hair, once formed, is independent of the organism, with which opinion he disagrees, instancing *Plica polonica* as opposed to such a theory. He gives the following cases:—

1. A British officer in India, forty-eight years old, fell into bad health, and became prematurely gray. He returned to England, regained his health, and in four years his hair returned to its original brown.

2. In a man sixty-seven years of age, hair white, chest covered with long white hair, the chest was blistered; and when hair grew out over the blistered surface, it was black.

3. In a man, aged thirty-five, bald, a small blister the size of a crown piece was applied to vertex for congestion of the brain. Growth of hair followed over the blistered surface.

4. A lady, hair of vertex gray and very scanty, applied tar-water. Hair grew, and was of natural color.

5. The same occurred in another case after application of citrine ointment.

In the *Boston Medical and Surgical Journal*, 1851, is reported a case of a man thirty years old whose hair was scared white in a day by a grisly bear. He was sick in a mining camp, was left alone, and fell asleep. On waking, he found a grisly bear standing over him.

A second case is that of a man of twenty-three years who was gambling in California. He placed his entire savings of eleven hundred dollars on the turn of a card. He was under tremendous nervous excitement while the cards were being dealt. He won. The next day his hair was perfectly white.

¹ Dr. Gray of the Army Medical Museum.

² Philadelphia Medical Museum, 1807, vol. iii. p. 219.

¹ London Lancet, 1853, p. 556.

² Dublin Quarterly Journal of Medical Science, 1847.

In the same article is the statement that the jet-black hair of the Pacific Islanders does not turn gray gradually; but when it does turn, it is sudden, usually the result of fright or sudden emotions.

The following cases are of change of color from white to black:—

Dr. Bruley,¹ physician to the Fontainebleau, reported to the Society Médicale, Paris, in 1798, the case of a woman sixty years old, whose hair, naturally white and transparent as glass, became jet-black four days before her death (phthisis). On examination after death, the bulbs of the black hairs were of immense size and engorged with dark pigment. The roots of white hairs that remained were dried up, and two-thirds smaller in size.²

Dr. Alanson Abbe² mentions the case of Dr. Capen, who had become gray, but, on recovery from disease, his hair became quite dark.

In the *St. Louis Medical and Surgical Journal*, 1845, p. 310, there is reported the case of an old man eighty-one years of age, robust and hale. His hair, from being perfectly white, became black, and the same of the beard. This man also presented the phenomena of second sight. He could read readily without glasses. The text-books on skin-diseases also mention cases. Several cases of sudden canities are referred to in Ziemssen.

Brown-Séquard, in his own person, noticed one day a white hair in his beard where there was none the day previous. He pulled it out, and the next day others appeared. This was observed repeatedly, and there was no doubt the hair in its entire length turned white in one night. Under the microscope these white hairs showed small air-bubbles in place of the normal pigment. In a case of hemiplegia the hair became white on the paralyzed side. The same has been reported in cases of neuralgia. Other anomalous cases have been noted where the hair became white in patches, and where individual hairs have been seen alternately white and black at different stages of its growth, to which condition Karsh and Landois have given the name of "ringed hair," and ascribed it to an intermittent trophic disease affecting the hair-follicle. Wilson³ mentions a case where the hair was gray in winter, and regained its normal color in summer.

Alibert⁴ and Beizel relate cases of women with blond hair which all came out after severe fever, and when new hair grew it was black. Alibert also relates the case of a young man who lost brown hair during illness, and that which replaced it was red. In the case of an epileptic girl of idiotic type, with alternating phases of stupidity and excitement, during the stage of stupidity the hair was blond, during excitement it was red. This change of color took place in two or three days, the change always beginning at the ends of the hairs. Pale hairs showed an increased number of air-spaces. It has been frequently observed, that, when the hair changes color gradually, the change begins in the end, and extends toward the bulb. In conversation with an eminent ornithologist on the change of color in the plumage of birds, he said, "I have lately been watching hairs in my mustache turn gray, and they always begin at the ends, and it extends to the roots."

Speaking on the subject with a lady, she mentioned the case of the physician who attended her at the seashore last summer. The doctor's hair was long and quite gray. One day he came in to see her after having his hair cut, and she was surprised to notice that the gray hair had given place to black. Examination showed that his hair towards the ends had been white, and that nearer the skin black. The white portion had been removed by the cutting.

The cases here collected are only a few in comparison to what might be found; but they are sufficient to prove beyond all reasonable doubt that the hair does suddenly change color under certain circumstances, and that the change takes place in existing hairs.

Analogous to changes in the color of the hair in man are the changes which occur in the lower animals. In animals and birds such changes are often periodical, as in their summer and winter coats. This occurs to a very marked degree in a great many species. Thus the ermine in summer is dark brown, in winter is pure white. Among birds the ptarmigan is white in winter, and brown in summer. So with our familiar bobolink, yellow in fall, in spring black and buff. As to the question whether, in birds and animals, this change takes place in individual feathers and hairs, or whether all the old plumage and fur is shed by moulting, recent investigations favor the view that it is due to both. Dr. Elliott Coues¹ says it may be either or both. Mr. Robert Ridgway (Smithsonian Institution) inclines to the opinion that in birds it is accomplished by moulting. Dr. Louis Stejneger (Smithsonian Institution) was formerly of the same opinion, but recent studies have inclined him to the belief that there is also a change in the color of existing feathers. He was led to this change of belief by a critical study of the changes in color of the black and white fly-catcher of Europe, and especially from an examination of a series of twenty-seven specimens of the narcissus fly-catcher (*Xanthophygalia narcissina*) of Japan. His studies in full will appear in the "Proceedings of the United States National Museum, 1889." Dr. C. Hart Merriam, ornithologist of the Agricultural Department, in a letter dated June 12, 1889, says, "The change from fall to spring plumage in birds is due to moult—without exception, as far as I am aware. In the case of mammals the matter is now in dispute. Probably in the majority of cases it is due in part to moult, and in part to actual change in the color of existing hairs. . . . The change in color from immaturity to maturity is always due to the growth of new hairs or feathers."

That the change in birds and mammals is due in part, at least, to change of existing coats, seems established. Sometimes this change is almost sudden, as where the change of season is very abrupt. In such case, of course, there would not be time for the growth of new hair or plumage.

In the golden plover (*Charadrius dominicus*) the black belly of summer changes to white in winter. While this change is taking place, individual feathers, part black and part white, may be seen. In Bonaparte's gull, a common gull of our coast (*Larus Philadelphia*), the black of the head of summer changes to white in winter, principally by change in color of existing feathers.

Another interesting feature of this question, as bearing on the change in the color of the hair by drugs, is the influence

¹ Boston Medical and Surgical Journal, 1852, p. 406.

² Wilson, Skin Diseases, p. 377.

³ Drockner, Diseases of the Skin, 1888.

¹ Fur-Bearing Animals.

of certain substances administered as food, in changing the color of tissues in some of the lower orders. In orange canaries it has come to be an established fact, that, by feeding the parent bird with a certain kind of food the active ingredient of which is cayenne pepper, the offspring will be of an orange color; and orange-colored canaries may be seen in the stores of most bird-fanciers. A food for producing orange canaries is extensively advertised by a bird-dealer in Baltimore (Bishop). It is reported that the Indians of the Amazon cause green parrots to change to yellow and red by feeding them upon the fat of a certain fish allied to the shad.¹ Dr. Merriam, in the letter previously quoted, says, "It is well known that food affects the color in birds. Red purple finches and pine grosbeaks invariably turn yellow when caged. This is due undoubtedly to the absence of some important food-element. In some of the zoölogical gardens of Europe it is the custom to send white spoonbills and flamingoes to Amsterdam Garden to be recolored. The particular food by which Mr. Westermann accomplishes this end is a secret, but it is believed to be a kind of shrimp or small crustacean which has a quantity of red pigment in its shell."

In the same direction are the changes of color in other tissues by particular foods. It has long been known that when pigs are fed on madder their bones become red. This fact has been taken advantage of by physiologists in studying the structure and development of bone. The phosphate of lime acts on the coloring matter of madder as a mordant. When given intermittently to a growing animal, the bone presents alternate rings of red and white.²

Darwin³ mentions that pigs in Virginia eat the paint-root (*Lachnanthes tinctoria*), and their bones are colored pink, and it caused the hoofs of all but the black varieties to drop off. "From facts collected by Heusinger it appears that whiter sheep and pigs are injured by certain plants, whilst dark-colored individuals escaped. . . . On asking some farmers in Virginia how it was that all their pigs were black, he was informed that the black members of a litter were selected for raising, as they only had a chance of living."

Fleurens (1824) made use of madder for coloring the semi-circular canals of pigeons, to outline the canals more distinctly (see also Ferrier on "Functions of the Brain," and the writings of Vulpin, the French physiologist). Mr. Lucas, osteologist of the National Museum, informs me that the bones of the crow are made purple by feeding on pokeberries. Ridgway says the bones of the Western fox-squirrel are red, while those of its Eastern brother are white. No cause has been assigned for the difference. See experiments by Marci Paolini in 1841 ("Specimen quorundam experimentorum de vi Rubiae ad ossa ovorumque Gallinarum putamina calcariae coloranda," No. 1 of Miscellanei Medici, Pamphlet Vol. 1149). He gives a very good plate of the colored skeleton of a fowl, and also of its colored egg after four months feeding *Rubia tinctorium*. He also gives references to other authorities, the most satisfactory of which is Belchior ("Philosophical Transactions," vol. ix., 1732-44), who gives an account of feeding hogs and fowls with madder-root and wheat-meal. A rooster so fed died in sixteen days, and showed the condition admirably. Other writers take up the subject after him in the same publication.

¹ Wallace's Amazon.

² Todd's Cyclopædia of Anatomy and Physiology, vol. iii. p. 853.

³ Origin of Species, p. 9.

It is reported that among workers in cobalt and indigo the hair becomes blue; also, in artisans working with copper, the hair takes a greenish hue.

The color of butterflies can be changed according to the food upon which the caterpillars are fed. More remarkable still, perhaps, is the change of color in the chameleon and in many insects, according to the color of the substance with which they are in contact.

The environment undoubtedly has a powerful influence upon the coloring of animals and birds. This is clearly illustrated in every museum of natural history. Specimens from arid desert regions are uniformly of a dull appearance, compared with those from regions of luxuriant foliage.

M. G. Pouchet,¹ in his work "Mechanism of Change of Color in Fishes and Crustaceans," says that change of color in fishes is due to the size of contractile colored cells placed in the skin. These are under the influence of the nerves. The author found that the particular nerves controlling them (in the turbot) were nerves of the sympathetic system. By cutting the nerve supplying a particular area of the skin, he had been able to retain that area unchanged in color, while the rest changed as the fish found itself on a dark or light surface. That the eye is the means by which this change in its condition is communicated to the fish or crustacean, and that then reflex action takes place through the sympathetic nerves on the color-cells of the chromatophors, is proved by the fact, that, when the animal experimented on is blinded, no further change of color occurs when it is removed from light to dark or the opposite (see also *Monthly Microscopical Journal*, 1871, vol. vi., M. G. Pouchet on "Study of Connection of Nerves and Chromoblasts," principally in fishes and batrachians).

The reasons assigned by naturalists for periodical change in color of plumage or fur are twofold: (1) sexual selection; (2) as a protection against enemies.

1. Sexual selection. The male takes on a brighter and more attractive appearance to facilitate the business of courtship and the securing of a mate.

2. As a protection against enemies. In Arctic regions birds and mammals are usually white in winter, the color of the snow; so that they are with more difficulty found by their enemies. Darwin supposes that originally only a few individuals took on this change; and, these being better protected, gradually, by a process of natural selection, only the white variety was left.

It is apparent, from what has been said, that there is very much concerning the changes of color of the hair and other appendages of the skin in man and the lower animals that is not understood. In its normal condition, the color of the hair is dependent upon the hair-bulb. It is here that the melanine is secreted from the coloring-matter of the blood; and from this point, as the hair grows, it permeates its cells, the intensity and shades, from black to blond, depending principally upon the amount of the coloring-matter. In black hair the hair-bulb is larger, contains a greater amount of melanine, and the hair itself is coarser and of more vigorous growth. In those cases where the hair has turned from white to black, and minute examination has been made, this has been found true.

¹ Transactions of the British Association for the Advancement of Science, 1872, p. 152.

In the case reported by Bruley, already referred to, of a woman aged sixty, whose hair, previously white, became jet-black four days before her death, the bulbs of the black hairs are described as being of immense size and engorged with dark pigment, while the roots of the white hairs that remained were dried up and two-thirds smaller in size. So, on the other hand, in change from dark to white, the hairs finer in texture, less vigorous in growth, and the hair-bulbs smaller.

The sudden change in canities, when due to violent emotions, can be explained in no other way than through the bulb. It is true that there is no direct vascular or nerve connection between the bulb and its hair after it emerges from the skin, but it is also undoubtedly true that there is communication by osmosis between the cells of the papilla and those of the shaft and different layers of the hair.

Wilson¹ ascribes the cause of sudden whitening of hair to insufficient nutritive power of the skin, and also suggests that there may generate a gaseous fluid in the hair in place of its normal constituents. He says, further, that the fluids from the blood-vessels of the skin permeate the hair, and thus change in fluids may alter the color.

In all of the cases of sudden change to white, where the hair has been examined, the coloring-matter has disappeared, and in its place is found an accumulation of minute air-globules. The same is true of gray hair of advancing age. How the air gets into the capillary structure has never been explained. Two possible explanations are offered: one is, that in the destruction of the coloring-matter a gaseous substance may be developed; the other is, that air may find entrance from without, through the sides or end of the hair. It is possible to suppose a condition of the bulb producing a vacuum in the hair-shaft that shall cause, by suction, a drawing-in of air. The view that the air finds entrance through the end of the hair is supported in the fact that the change of color begins at the extremity.

Erector pili muscle has an important influence on pathological changes which take place in the hair-bulb. This minute muscle has its origin in the true skin, and, passing downwards, is inserted into the base of the hair-bulb; so that when it contracts it lifts the hair outwards, and compresses its papilla. The effect of sudden fright causes the hair to "stand on end" by contracting this muscle. Temperature has its influence with animals and birds. In cold weather (winter) the change is to white; in summer, to black. Cold, we know, contracts the skin, and thus probably causes pressure on the hair-bulb. That the hair is easily influenced by external causes, as well as those which come through its bulb, is fully demonstrated. The mere fact that it can be so readily dyed and bleached artificially, shows that the agents used for this purpose penetrate its substance. Bleaching-agents, such as chlorine, peroxide of hydrogen, and strong alkalies, act by removing the coloring-matter, and not by adding any whiteness of their own.

It remains to say a few words upon the subject of changing the color of the hair by substances taken internally.

1. In the human subject the only agent, as far as I am aware, which has been charged with changing the color of the hair, when taken internally, is jaborandi.

2. Cayenne-pepper food changes the color of canary-birds to orange. This is a well-known fact to bird-fanciers. I

tried in Washington to get a specimen, but was told it was not the season for them, that they came in the autumn; also that they soon relapsed to their original color unless the cayenne-pepper food was kept up.

3. The change of color in parrots by the Indians of the Amazon, from green to yellow or red, is produced by feeding the fat of a certain kind of fish (Wallace's Amazon).

4. The restoration of certain birds to their original brilliant colors at the Zoölogical Garden, Amsterdam, is the result of feeding a kind of shrimp or small crustacean.

5. As analogous to the above, is the effect of madder in staining the bones of pigs red, and of poke-berries coloring crows' bones purple.

It might be of interest to study the influence of diet and habit upon the color of hair in different nations of men; as, for instance, why the Saxons have light hair, and the Gauls black hair. It is within the bounds of possibility, also, that discoveries may be made in the future by which the color of the hair in the human race may be modified by judicious treatment of the parents.

Some colors of hair are not popular, especially with ladies, and it is not likely that cayenne pepper will ever become popular to produce the orange hue; but if its antithesis should be discovered, and the orange changed to black or blond, then perhaps the gentle maiden with auburn hair will disappear, and the white horse be left in melancholy solitude.

In the *Philadelphia Medical Times* of July 2, 1881, I published a case entitled "Remarkable Change in the Color of the Hair from Light Blond to Black in a Patient while under Treatment by Pilocarpin,—Report of a Case of Pyelo-Nephritis, with unusually Prolonged Anuria." This was a case of a lady twenty-five years of age, and the drug was used to relieve the uræmic symptoms resulting from the anuria, which latter was extreme. On Dec. 16, 1880, treatment of pilocarpin hydrochlorate hypodermically was commenced, the dose given being one centigram (one-sixth of a grain). The effect of this was very prompt; and the sweating and salivation produced, most profuse. The relief to the uræmic symptoms was complete, the patient falling into a quiet sleep as soon as the effect of the drug ceased, and sleeping all night, awakening in the morning bright and refreshed. The pilocarpin was thus used twenty-two times from Dec. 16, 1880, to Feb. 22, 1881, requiring thirty-five or forty centigrams. As the patient became accustomed to the medicine, it was found necessary to give two centigrams at a dose. After Feb. 22 she began to improve, and no more was required. All her life up to November, 1880, the hair was a light blond. Four specimens of the hair were sent to the editor of the *Philadelphia Medical Times*, with the report of the case, for his inspection, and were as follows: (1) November, 1879; (2) November, 1880 (on this and the preceding date the color was the same, a light blond, with tinge of yellow); (3) Jan. 12, 1881, a chestnut-brown; and (4) May 1, 1881, almost a pure black. The growth of hair was also more vigorous, and individual hairs thicker. I believed at the time, and still believe, that this change of color was caused by the pilocarpin. The lady is still, at this date (March 10, 1889), under my observation. Her hair is now dark brown, having returned to that color from black. The full report of this case can be found in the *Philadelphia Medical Times* for July 2, 1881.

The following case is reported as adding another to the evidence that jaborandi will produce the effect mentioned under favorable circumstances. Mrs. L., aged seventy-two years, was suffering from Bright's disease (contracted kidney). Her hair and eyebrows have been snow-white for twenty years. She suffered greatly from itching of the skin, due to the uræmia of the kidney-disease; skin harsh and dry. For this symptom fluid extract of jaborandi was prescribed, with the effect of relieving the itching. It was taken in doses of twenty or thirty drops several times a day, from October, 1886, to February, 1888. During the fall of 1887, it was noticed by the nurse that the eyebrows were growing darker, and that the hair of the head was darker in patches. These patches and the eyebrows continued to become darker, until at the time of her death they were quite black, the black tufts on the head presenting a very curious appearance among the silver-white hair surrounding them.

At the time the first of these cases was reported, the facts as stated were received with considerable incredulity, the editor of one well-known Western medical journal openly refusing them credit. Others preferred the charge that the lady had formerly bleached her hair, and that when this was no longer possible her hair returned to its original color. In reply to these "suggestions," I will only say that the facts are known to scores of people at her home in Washington, D.C., and are entirely beyond question.

As illustrating the ubiquity of the daily press, and the ease with which all sorts of nostrums, valueless or otherwise, may be brought into notice through the newspapers, and how easy it is to make such a matter profitable to the advertiser, I mention an incident in connection with the case just reported.

It seems that some enterprising newspaper-man became cognizant of the case, and put a short notice in a New York daily paper to the effect that a drug had been discovered that would turn white hair black, and make hair grow on bald heads, giving my name as being connected with the Smithsonian Institution. This paragraph must have been extensively copied in newspapers both throughout this country and abroad. The first intimation I had of its existence was an avalanche of letters from all parts of the country wanting information, some offering money for the receipt, others enclosing money in advance; which latter, be it known, I at once returned. One from London, England, enclosed the half of a two-dollar bill, with the information that the other half would be speedily forthcoming on receipt of the formula or medicine.

These are the only cases thus far reported in which pilocarpin has been supposed to change the color of the hair.

In 1879 Dr. G. Schmitz¹ of Cologne reported two cases in which pilocarpin stimulated the growth of the hair in alopecia. One patient, aged sixty, was completely bald. Pilocarpin was injected subcutaneously for disease of the eye. After three injections, within a fortnight the head became covered with a thick down, which grew rapidly, so that in four months no trace of the baldness was left. No mention is made of the color. In the second case the patient, aged thirty-four, had a bald patch on top of the head the size of a playing-card. There was total restoration of the hair after two injections, in a short time.

Schöller¹ tells of similar results in animals in which alopecia had been produced by injections of bacteria.

Oscar Simon² relates the case of a woman, aged thirty, who had general baldness,—head, eyebrows, eyelashes. In a few weeks, after twenty injections of pilocarpin, the hair of the whole body was restored. In other cases so treated there was no effect whatever.

Landesberg³ of Philadelphia says that in more than a hundred cases of eye-disease treated by pilocarpin he observed no effect whatever upon the growth of the hair. The dose and mode of administration are not mentioned.

In 1882 Julius Pohlman⁴ experimented on white rabbits by hypodermic injections of pilocarpin. The dose used was large,—one grain three times a day. No change in color was noted in pure white rabbits. In partly-colored animals, white and brown, in one a brown spot on the back of the head deepened, and spread to a remarkable degree down the back and sides of the animal to the legs. In other individuals no change was noticed. Post-mortems in these animals showed enlarged spleen and altered suprarenal capsules.

D. W. PRENTISS.

POISONING BY MUSSELS.

IN the *Lancet*, July 26, 1890, Sir Charles A. Cameron of Dublin says, "On June 30, Mrs. O'Connor, her five young children, and her maid-servant, residing at Seapoint, County Dublin, partook of a meal of stewed mussels. In about twenty minutes after the ingestion of the mussels, some of the children stated that they felt a prickly ('pins and-needles') pain in their hands. Graver symptoms rapidly supervened, and in less than an hour one of the children died, the mother and three other children succumbing within two hours after eating the mussels. The chief symptoms were vomiting, dyspnoea, swelling of the face, want of co-ordination in movement, and spasms, principally in the arms. The patients appeared to have died asphyxiated, their faces being intensely livid. One of the children and the maid (the latter had eaten but few of the mussels) suffered very much, but recovered. Medical assistance came rather late, and was not of much use. The mussels had been procured from a small sheet of water to which the sea had access, but which received fresh water and some sewage. Examinations of the water at low and high tides showed that its saltness was twice as great when the tide was in,—a proof that land water drained into it when the tide was out. This land drainage would necessarily, from local conditions, be impure.

"It was deemed necessary for judicial purposes, that the cooked mussels, and the matters vomited by the patients, should be examined for ordinary poisons. This was done, with negative results. The uncooked mussels, compared with mussels of the same size from the open sea, appeared to have much larger livers, and their shells were very brittle. An attempt to extract an alkaloid was made. The generic tests applied, clearly proved the existence of a leucomaine, which, indeed, was obtained in crystals visible under the microscope, and corresponded to those described by Brieger as existing in the poisonous mussels which he examined. The quantity of material available did not, however, yield a sufficient quantity of the leucomaine for a thorough examination. I have procured a supply of mussels from the pond in which the poisonous mussels were found, and hope to be able to extract from them a substantial quantity of the leucomaine, which will probably be found identical with Brieger's mytilotoxine ($C_8H_{15}NO_2$). The mussels are mixed with mud having an offensive odor.

"The Seapoint case is another instance of poisonous mussels be-

¹ Klebs's Archiv, 1879.

² Berliner Klinische Wochenschrift, 1879.

³ Medical Bulletin, Philadelphia, 1882.

⁴ Buffalo Medical and Surgical Journal, 1882, p. 441.

¹ Berliner Klinische Wochenschrift, No. 4, 1879; Medical Bulletin, Philadelphia, 1882.

ing procured from foul or stagnant water. In this case the opinion of M. Dutertre, that the liver of poisonous mussels is the seat of disease and the generator of the poisonous leucomaine, seems confirmed; but I cannot agree with the French observer, that the disease is never the result of the poisonous nature of the food of the mussel. I have read all, or nearly all, the cases of mussel-poisoning on record, and I gather from such details as are given with respect to the places in which the mussels were found that they were in contact with sewage or stagnant water."

RECENT THEORIES OF GEOMETRICAL ISOMERISM.¹

THE histologist places a section of organized tissue upon the stage of his microscope, and studies its structure. He reports upon the cells and their contents, for he has seen them, but he has not detected the molecule. The smallest discernible particle was probably an aggregate of at least a million molecules of elaborate structure, permeated by many times as many molecules of simpler composition.

The actual configuration of atoms in the molecule, the bonds by which they are united, the mechanism which effects transformations from one form to another, and, indeed, the very existence of molecules, are subjects which do not belong to the world of sight. It is not likely that any human eye, with the most perfect optical instruments, will ever penetrate these secrets of an unseen world.

But the many unseen worlds are favorite hunting-grounds of science. The imagination of the geologist sees successive strata in regular order or thrown into folds, where the rocks are hidden from the uninitiated by drift, soil, and forest, or even where they were long since removed by erosion. The astronomer, having discovered a simple law controlling the motions of the planets, pursues them with the formulas of dynamics and perturbations, until the unexplained residuals of motion lead him to the very spot occupied by Neptune. The biologist experiments upon the vitality of invisible germs, but the chemist reasons upon the elements that make up molecules of which these germs consist. He recognizes atoms having simple, double, triple, and quadruple power of union. Whatever be the nature of this union, the "bonds" are as real as ever held prisoner to Roman soldier. The structural formulas which characterize the language of modern chemistry express the fact that each atom is specially related to a certain one or more other atoms, with scarcely the least claim in regard to distance or direction.

The doctrine of valence and types prepared the way for the more elaborate doctrines embodied in structural formulas, which so admirably explain numerous re-actions and isomers. Such is our ignorance of the actual relations of the atoms in space, that no photographs of geometrical isomers can be offered for inspection; yet certain working hypotheses of their configuration, which were received for some years with great reserve, have recently had such influence in shaping the current of research in organic chemistry, that they are well worth our attention at this hour.

When the quadrivalent character of carbon was distinctly recognized, as in CH_4 , it was probably not long before the regular tetrahedron often occurred to thinking minds as a suitable representation. If CH_4 thus represents the outline of a regular tetrahedron, it must not be supposed that the actual form is changeless, but rather that the mean positions of the hydrogen atoms are at the angles. In substitution products, we may think of the several radicles oscillating about mean positions that are at unequal distances from each other, the mutual attraction of the most unlike groups bringing them somewhat towards each other. The conditions in the two forms (see below) are so far identical that the mean mutual distance of any pair of groups will be the same in both. The difference would not be likely to make one form more easily soluble or volatile than the other. The usual means of distinguishing isomers may fail. Ordinary methods of fractional distillation or precipitation are alike useless to distinguish tweedledum and tweedledee. A most delicate instrument, capable of feeling the slightest resistance to the vibrations of luminiferous ether, is

found in a ray of polarized light. When such a ray passes through the asymmetric molecule, it is probable that greater resistance will be met in some one plane than in another, and thus the plane of polarization is slightly turned. In a fluid aggregate, a ray will meet successive molecules in all possible positions; and while these must have unequal effects,—sometimes, perhaps, in opposite directions,—the mean result for a large number will always be the same.

Le Bel and van't Hoff were the first to state clearly (and independently) the fundamental principles upon which this branch of chemical investigation has been developed. In the first place, when carbon is linked with four different radicles, two isomers will usually result, the forms of the molecule being related to each other as an object to its image in a plane mirror. These isomers closely resemble each other in most physical and chemical properties. Two such atoms may be represented by tetrahedrons, united at the corners, where it is important to note the cyclical order of the radicles attached to each carbon atom as seen from that atom itself.

Our theory must conform, however, to the observed facts; otherwise we may either be overwhelmed with a multitude of imaginary isomers, or we may be unable to account for all that are discovered. The following principle (which has been known as "van't Hoff's second hypothesis") is supported by many facts: When two atoms of carbon are united by a single bond, each is capable of free rotation in either direction about the common axis; and isomers may be recognized for those bodies only which cannot be brought into the same configuration by such rotation. But some apparent exceptions must not be ignored, especially a marked exception to the principle of free rotation, announced two years ago by Auwers and V. Meyer.

Again, using the tetrahedron as the symbol of the carbon atom, we may conceive two such forms united on a common edge, with hydrogen at the four free corners, to represent the molecule of ethylene (C_2H_4). In like manner, acetylene derivatives may be represented by two tetrahedrons with a common face.

Finally the theory of rings was discussed. A campaign is thus being conducted towards the stronghold of atomic mysteries.

The current theories of stereochemistry or geometrical isomerism are based upon those residuals of observed facts that find no explanation in the usual doctrine of structural formulas. Any complete bibliography, covering all the experimental evidence that may bear upon this subject, must therefore include all reactions or properties that aid us in determining the constitution of the many compounds capable of appearing in geometrical isomers. In the list appended to Professor Warder's paper an attempt is made to include those papers only that may be most useful to chemists or physicists desiring to acquaint themselves with the history of the stereochemical conception, its originators, supporters, and opposers. The full value of Professor Warder's paper cannot be appreciated without the use of the many diagrams which are not available for our use.

NOTES AND NEWS.

THE pressure of natural-gas wells in Indiana and Ohio is steadily diminishing, the diminution having already amounted to between 30 and 40 per cent. Professor Orton urges the imperative necessity of cities and States taking action to restrict wasteful use of gas; but even the strictest regulations, he says, cannot prevent the exhaustion of the supply in a few years. In this connection, says the *Engineering and Mining Journal*, it is interesting to note that the Pennsylvania Company has taken the step of refusing to sell natural gas in Erie, Penn., except by metre, charging 22½ cents per 1,000 cubic feet, in order to prevent waste of the gas. No factories are to be furnished at any point on its line, as all the gas will be used for domestic purposes.

—The American Folk-Lore Society will hold its annual meeting in New York City on Nov. 28 and 29, these dates being the Friday and Saturday following Thanksgiving Day. The sessions will be held at Columbia College, in rooms kindly placed at the disposition of the society by President Low. Last year the annual

¹ Abstract of an address before the American Association for the Advancement of Science, by Robert B. Warder, vice-president of Section C.

meeting was held in Philadelphia, and was signalized by a large attendance and the formation of a local chapter of the national society, which has held meetings monthly throughout the winter. It is hoped that all persons interested in folk-lore will consider themselves invited to attend the meetings at Columbia College, when several interesting papers will be read, and that many will unite with the national society, as an increase in membership in New York and Brooklyn is desirable. The officers of the society for 1890 are as follows: president, Dr. Daniel G. Brinton (Philadelphia, Penn.); council, Hubert Howe Bancroft (San Francisco, Cal.), Franz Boas (Worcester, Mass.), H. Carrington Bolton (New York, N.Y.), Thomas Frederick Crane (Ithaca, N.Y.), Alice C. Fletcher (Nez Percés Agency, Idaho), Victor Guilloft (Philadelphia, Penn.), Horatio Hale (Clinton, Ont.), Mary Hemenway (Boston, Mass.), Henry W. Henshaw (Washington, D.C.), Thomas Wentworth Higginson (Cambridge, Mass.), William Preston Johnston (New Orleans, La.), Charles G. Leland (London, England), Otis T. Mason (Washington, D.C.); secretary, W. W. Newell (Cambridge, Mass.); treasurer, Henry Phillips, jun. (Philadelphia, Penn.). The society publishes the *Journal of American Folk-Lore*, a quarterly in octavo, bearing the imprint of Houghton, Mifflin, & Co. It is sent free to members. The membership fee is three dollars per annum. Persons desiring to join the society, or to receive the circular containing the particulars of the meeting, should address Dr. H. Carrington Bolton, University Club, New York City.

—Up till quite lately, says *Engineering* of Sept. 19, the whole of the guns for the Belgian Army were obtained from Essen; but, in the presence of the immense progress of the Belgian steel industries, it was only to be expected that an attempt would be made to change this state of affairs. A number of cannon were accordingly designed by the officers of the Belgian artillery, and manufactured in the Royal Foundry, Liège, from steel obtained from the Cockerill Company. Comparative tests of these guns and a number of Krupp guns of similar type were arranged, and have just been brought to a successful conclusion. In the first series of trials in which the ballistic qualities were to be tested, the guns selected had in each case a caliber of 5.9 inches; and a mortar, a howitzer, and a cannon of foreign and of domestic manufacture were selected. The Belgian mortar was 45 inches long, and weighed 8.2 hundredweight; while the corresponding Krupp gun was 37.4 inches long, and weighed 7.1 hundredweight. The Belgian howitzer was 83 inches long, and the Krupp 70.8 inches, whilst the dimensions of the cannons were more nearly equal. Both sets of guns were fired with the same charges, though these were above the proper limit for the Krupp guns, which must have been at a disadvantage in consequence. As was only to be expected under the conditions, the native-made guns gave somewhat better results, the ranges of the mortars and howitzers exceeding those of the Krupp guns by from 250 to 200 yards. The results with the cannon were practically identical.

—Experiments made at the Ohio Experiment Station for the past three years indicate that the plum curculio can be kept in check by spraying with Paris green or London purple in water solution. But, while this remedy was applicable to apples and plums, it could not safely be applied to peaches, because the foliage of the latter is so easily injured by the poison. Professor Bailey of the Cornell University station has been experimenting in spraying peaches this year, and in a bulletin just issued announces the following summary of his results: 1. Peach-trees are very susceptible to injury from arsenical sprays; 2. London purple is much more harmful to peach-trees than Paris green, and it should never be used upon them in any manner; 3. Injury is more liable to occur upon full-grown foliage and hardened shoots than upon young foliage and soft shoots; 4. The immunity of the young growth is due to its waxy covering; 5. Injury late in the season is more apparent than early in the season, because of the cessation of growth; 6. Injury from the use of London purple may be permanent and irreparable; 7. The length of time which the poison has been mixed appears to exercise no influence; 8. London purple contains much soluble arsenic (in some samples nearly 40 per cent), and this arsenic is the cause of injury to peach foliage; 9. A coarse spray appears to be more injurious than a fine one; 10. A

rain following the application does not appear to augment the injury; 11. Meteorological conditions do not appear to influence results; 12. Spraying the peach with water in a bright and hot day does not scorch the foliage; 13. Paris green, in a fine spray, at the rate of one pound to 300 gallons of water, did not injure the trees. Probably one pound to 350 gallons is always safe.

—The following is a list in brief, according to *Nature*, of subjects on which the Dutch Society of Sciences at Haarlem invite research: a history of the mathematical and physical sciences in Holland; isomorphism; minerals in the river and dune sands on the Dutch coast; the accessory sexual glands in mammalia; heat liberated in solution of various salts in water; decomposition of water or other liquids by disruptive electric discharges within or on the surface; influence of compression in different directions on specific inductive power; determination of the form and position of the reticular micrometers used by Lacaille at the Cape of Good Hope; influence of volume of molecules on pressure of a gas; relation between density and chemical composition of transparent bodies, and the index of refraction; modification of reflected light by magnetization of some other metal than iron; methods of obtaining and fixing new varieties in cultivated plants; rôle of bacteria in filtration of potable waters through a layer of sand; bacteria and azotized combinations in the soil; healing after grafting.

—The last number of the *Kew Bulletin* contains a note on the properties and uses of the jarrah-wood, a species of eucalyptus native to western Australia. The main difficulties in connection with its use in this country are the cost of freight for such heavy timber from Australia, and its intense hardness, which makes it difficult, for ordinary English carpenters' tools, to work it. The tree which produces it grows generally to a height of a hundred feet, and sometimes a hundred and fifty feet. It is found only in western Australia, extending over the greater portion of the country from the Moore River to King George's Sound, forming mainly the forests of these tracts. According to Baron Mueller, when selected from hilly localities, cut while the sap is least active, and subsequently carefully dried, it proves impervious to the borings of insects. Vessels constructed solely of it have, after twenty-five years' constant service, remained perfectly sound, although not coppered.

—The steel-armor tests at Annapolis—the first armor-plate tests ever made in this country—were completed on Monday, Sept. 22. The plates used were one of solid steel with about 0.33 per cent of carbon; and the other of the composition known as nickel steel, being mild steel with 5 per cent of nickel; and a plate of a compound of steel and iron, under the Wilson patent. The plates were set side by side, and were backed with 36 inches of oak. The gun used on the first series of tests was a 6-inch rifle, 17 feet and a half in length. It was set with its muzzle 30 feet from the plates, and was mounted on a carriage, so that it could be turned to point squarely against any part of either plate. The projectiles were Holtzer chrome steel shells, 17 inches long, 6 inches in diameter, and weighing 100 pounds. The firing charge was 44½ pounds of cocoa-powder. The initial velocity was about 2,075 feet per second, giving a muzzle energy of 3,342,876 foot tons. Four shots were fired at each plate. Each plate was four feet high and 6 feet wide, and 10.5 inches thick. On Sept. 22 the tests were concluded by a shot at each plate with an 8-inch rifle firing an armor-piercing projectile. The projectile weighed 210 pounds, and was fired by a charge of 85 pounds of powder, giving an initial velocity of 1,850 feet per second. It appears from these tests, says *Engineering News*, that the solid steel armor is far superior to the compound armor having a hard steel face and a wrought iron back, when tested with modern high-power guns using armor-piercing projectiles. As regards the relative efficiency of the steel plate and the nickel-steel plate, the latter must be conceded to have proved, on the whole, the better defence, as it was not cracked by the 8-inch shot in the centre, as was the all steel plate. On the other hand, the penetration of the all steel plate was in almost every case less than that of the nickel steel, thus showing the latter to be somewhat softer and tougher than the former.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

CHANGES IN COLOR OF HAIR AND FEATHERS. <i>D. W. Prentiss</i>	183	Is Cancer Contagious too?.....	191
POISONING BY MUSSELS.....	187	Treatment of Tuberculosis by the Vaccine Method.....	191
RECENT THEORIES OF GEOMETRICAL ISOMERISM.....	188	A Return to Blood-Letting.....	192
NOTES AND NEWS.....	188	LETTERS TO THE EDITOR.	
THE STUDY OF FOLK-LORE.....	190	Professor Hazen and Espy's Experiments. <i>Wm. Ferrel</i>	192
HEALTH MATTERS.		BOOK-REVIEWS.	
Improved Sanitation in London..	191	Belief in God; its Origin, Nature, and Basis.....	193
Removal of Micro-Organisms from Water.....	191	AMONG THE PUBLISHERS.....	193
Why He renounced Vegetarianism.....	191		

THE STUDY OF FOLK-LORE.¹

THE term "folk-lore" seems to many persons to cover a field of study not clearly defined; but this quality of indefiniteness is common to all terms used to denote studies connected with the intelligence of man. "Anthropology," "ethnology," "psychology," are each terms embracing a vague and infinitely extended field, which, in practice, is limited by more or less arbitrary boundaries.

By "folk-lore" is to be understood oral tradition,—information and belief handed down from generation to generation without the use of writing. There are reasons why the mass of knowledge (including history, theology, and romance) which has been orally preserved in any people should be set aside as capable of independent treatment. Such matter must express the common opinion, or it would not be remembered; it must be on a level with the notions of the average rather than of the exceptional person; it must belong, that is, to the *folk* rather than to individuals.

The term "folk-lore" has its most definite significance in connection with civilized peoples of modern Europe, having been invented by an anonymous correspondent of the London *Athenæum* (Aug. 22, 1846), who signed his name Ambrose Merton, understood to be a pseudonyme for W. J. Thoms. He included under this title "manners, customs, observances, superstitions, ballads,

proverbs," and claimed the honor of introducing into the language the word "fo'k lore," as Disraeli had claimed the honor of "fatherland." The latter word has not met with success; but "folk-lore" has been accepted not only in English speech, but also in most European languages.

It was soon evident that the oral traditions of Europe could not be treated by themselves without consideration of oral traditions in other parts of the globe. Customs and superstitions found in the United States, for example, not only among recent immigrants, but also in families of the purest English stock, have evident connection with practices and beliefs widely extended among savage tribes. It was therefore necessary to extend the term "folk-lore" so as to cover these. There was some protest against these, inasmuch as the name "folk" belongs properly to races in which isolated tribes have been amalgamated into something resembling a nation; but this difficulty could not be allowed to prevent a convenient inclusion. So the expression came to be used, first in a definite sense, as including tales, beliefs, and practices now retained among the unlettered peasantry of Europe; second, with a wider connotation, as embracing traditionary tales, customs, and usages of uncivilized races. In its broader meaning, therefore, folk-lore is a part of anthropology and ethnography, embracing the mental side of primitive life, with especial reference to the narratives in which beliefs and habits are related or accounted for.

The subject has two sides,—the æsthetic or literary aspect, and the scientific aspect. Remarks were made on folk-lore from each of these points of view.

In treating of the literary side of folk-lore, the lecturer took his illustration from English ballads. The character of the ballad as a dance-song (late Latin *ballare*, "to dance") was pointed out, and it was shown that dancing in couples, as a mere mode of motion, was comparatively modern. According to more ancient usage, a dance was a dramatic performance, setting forth a story, which was related in a song serving to guide the movement. An illustration of this custom was still to be seen in the "ring-games" of children. The date of collection of English ballads, and the periods of their composition, formed the theme of observations. It was shown that the circumstance of the late recording of many ancient ballads in Scotland had led to the erroneous supposition that Scotland had possessed a distinctively national song, unlike that of England; the fact being that so-called Scottish ballads were only dialectic survivals of songs formerly common to all parts of Great Britain. For the origin of these compositions it is necessary to look beyond the limits of English speech; mediæval ballads not being the property of any one European country, but in a measure a common stock.

The qualities which rendered these songs of interest were remarked on, and popularity, simplicity, and antiquity were named as constituting the charm of the ballad. What has been repeated for centuries, has passed from lip to lip, and formed the joy of all classes, must stand on a different level from sentences penned for a chosen few. Ballads show that there was a period in which the mediæval noble and the mediæval serf stood nearly on the same intellectual level. These compositions serve as a perpetual lesson of simplicity, and will always be of value to bring literature back to that character of naturalness and simplicity in which true art must consist.

Proceeding to treat of the scientific side of the study, an example of a surviving American superstition was cited in the practice still in use in certain parts of the country to charm rats away from houses by writing letters to them. A specimen of such a letter was read, for the accuracy of which the lecturer could vouch, the district being the seacoast of Maine. It was shown that this method of ridding a house of rats was also occasionally used in Maryland. Comparisons from Scottish folk-lore showed that the superstition was spread throughout the English-speaking world. The custom was also shown to prevail widely in France, and its origin traced to the mediæval practice of addressing legal citations and ecclesiastical admonitions to animals.

Following out the subject into the belief of savage tribes, the underlying principle was shown to be a doctrine respecting the identity of animal and human existence. In uncivilized races,

¹ Abstract of an address to the New York Academy of Sciences, March 24, 1890, by William Wells Newell, secretary of the American Folk-Lore Society.

animals are supposed to be actuated by the same motives as men, and their communities to be organized according to the rules of ethics that prevail in human society. Examples of the relation of animals and mankind were taken from the religious medicine of the Cherokees. Finally an account was given of the universal belief that animals can assume the human form, and appear at pleasure in that manner. In this manner it was made to appear that no account could be given of the American superstition without examining the character of primitive belief.

Finally the great psychological importance of the collection of folk-lore, and the necessity of immediate effort to preserve a record of it in this country, were dwelt upon. As the secretary of the American Folk-Lore Society, the lecturer presented the claims of that body, and expressed a hope that steps would be taken to increase interest in the study in New York, and to obtain more general co-operation in the important task lying before collectors and special students.

HEALTH MATTERS.

Improved Sanitation in London.

DR. B. W. RICHARDSON, in his abridgment of "The Health of Nations," gives a comparison of mortality in the Elizabethan and Victorian eras: "According to John Graunt's reports, from the parish registers, the condition of the whole city of London in the time of Queen Elizabeth was very much that of a 'slum.' The death rate was, in fact, that of a slum (it was more than 40 per thousand); but now, under some advance towards unity and centralization, it is about 20 per thousand, still including upwards of one-third of preventable deaths. The death-rate then largely exceeded the birth-rate, while now the reverse is the case. The death-rate of the children under five years was then one third, or 33 per hundred: it is now 27 per hundred, and grievously too heavy. The deaths from old age, or the age then called old, of seventy, were 7 per cent: they are now sadly too low, but even in the city proper they are 18 per cent. As to personal security, John Graunt boasted that not more than one in two thousand was then murdered annually, which he ascribes to good local government. At the same rate now, murders in the whole of the metropolis should amount to no less than 2,500 annually, whereas they actually amount to an average of no more than 12 for the whole five millions of population,—a population which approaches to that of the whole kingdom of England and Wales in the time of Elizabeth."

Removal of Micro-Organisms from Water.

Dr. Krüger, considering the fact that more bacteria are usually present in rivers than in lakes, notwithstanding that lakes themselves in many cases are more or less polluted by rivers passing through populous towns, believes that this rapid decrease in the number of organisms may very possibly be due in part to the action of direct sunlight, but in the main to the tendency of water in a comparatively undisturbed state to deposit and precipitate. He therefore carried out a number of experiments with a view to determine how far the removal of organisms was brought about by the mere mechanical deposition of inert matter, and also by precipitation as a result of chemical action. The mechanical precipitants employed, all in a state of fine powder and sterilized, were alumina, brick-dust, clay, chalk, sand, coke, and charcoal. Water obtained from an ordinary service-pipe was impregnated with a liquid containing a bacillus growth of a species incident to tap-water. This was divided into two portions,—one for precipitation with the inert substance, and the other was untreated for the sake of comparison. Experiments were similarly carried out in which precipitation was obtained as a result of chemical action such as is brought about by the addition to the water, containing naturally lime, magnesia, etc., substances like wood-ash, sulphate of alumina, and slaked lime. The general conclusion came to by the author from the results obtained, as we learn from the *Medical Record* of Sept. 27, is that undoubtedly large numbers of bacteria are carried down by inert substances merely sinking in the water, but that the action is very considerably increased when, in addition to mechanical deposition, a chemical precipitation also

takes place. The corollary is evident,—inert substances do mechanically assist in the precipitation of micro organisms, but preference should be given to chemical treatments.

Why He renounced Vegetarianism.

Dr. Alanus, the former leader of the vegetarians in Germany, has renounced his faith, and resumed the use of animal food, says the *Medical Record* of Sept. 27. In a letter written to a local paper, he gives the reasons for his apostasy. He had lived for a long time, he said, on a purely vegetable diet without experiencing any ill effects, feeling no worse and no better than he had formerly while living as the rest of mankind. One day, however, he found that his arteries were apparently becoming atheromatous. He was unable to account for this, as he was not a drinking man, and was still under forty years of age. Finally he came across a statement by Monin, to the effect that abstinence from animal food was a fertile cause of atheroma. He could hardly have been much of a student of dietetics not to have come across that theory until his own arteries had become diseased. There is nothing like taking comfort out of every thing, however; and he now consoles himself with the remark that he has "become richer by one experience, which has shown me that one single brutal fact can knock down the most beautiful theoretical building."

Is Cancer Contagious too?

The fact that certain spots constitute apparent foci for the spread of cancerous disease has ere now been noted, though we are still completely in the dark as to the causes which underlie these vagaries of distribution. It is, however, only by systematic close observation that we can hope to solve the enigma, and acquire the knowledge which alone will enable us to check the ravages of a terrible and implacable disease. Some observations made by Dr. Arnaudet in the little village of Saint Sylvestre-de-Cormeilles, in Normandy, are interesting in this respect. The village, according to the *Medical Press*, only numbers some four hundred inhabitants, but among them the deaths from cancer are four times more numerous than at Paris (14.88 as compared with 4.16 per hundred deaths). In the course of his inquiry into the causes of this special mortality, Dr. Arnaudet discovered that there were certain "cancer nests" which the theory of contagion could alone explain. The water-supply of these people is drawn almost exclusively from surface ponds; but he observes that very little water is drunk, though it is used in the manufacture of cider. He shows on a chart that the malady developed itself successively along a line corresponding to the water-supply supplying the ponds, and he is evidently strongly inclined to attribute the outbreak to the water, or, secondarily, to the cider. He subsequently extended his observations to four neighboring communes, in all of which the proportion of deaths from cancer was largely in excess of the normal rate. This inequality of distribution seems to point to the existence of local causative conditions, the nature of which it is highly important to elucidate.

Treatment of Tuberculosis by the Vaccine Method.

On Nov. 19, 1889, Drs. J. Grancher and St. Martin addressed to the Académie de Médecine, Paris, a sealed packet relating to a method of treatment and preventive inoculation of tuberculosis based upon numerous experiments which they had made on rabbits. The communication made by Dr. Koch to the Berlin Congress (of which the full text was published in the *British Medical Journal* of Aug. 16), concerning the results which he has obtained in rendering guinea-pigs refractory to tuberculosis, or in curing them of advanced forms of tuberculosis, has induced MM. Grancher and St. Martin to make known their researches on the same subject earlier than they would otherwise have done. In all these experiments they chose the rabbit as the subject of inoculation and intravenous injection, because there is thus produced a tuberculosis which kills very quickly, and at an almost fixed date, with constant lesions of the liver, the spleen, and the lungs, and which defies all local treatment. Tuberculosis thus induced being always fatal, a solid basis is thus secured which allows exact appreciation of the negative or positive results of any method which tends to produce the refractory state or to cure after infection. The

method employed by MM. Grancher and St. Martin was the injection of tuberculosis cultures attenuated in various degrees, and used like the dried spinal marrow in Pasteur's treatment of rabies and hydrophobia. Nine degrees of attenuation have been obtained, the four last being such that the cultivation remained sterile. The injections were made first with the most attenuated cultivations, and then with more and more virulent ones. The authors consider that by this method they have succeeded, on the one hand, in conferring on rabbits prolonged resisting power against the most certain and the most rapid experimental tuberculosis, and, on the other hand in conferring an immunity against that disease, the duration of which remains to be determined.

A Return to Blood-Letting.

M. Crocq, who has frequently written and spoken in favor of the revival of venesection, made a powerful speech dealing with this subject at a recent meeting of the Belgian Académie de Médecine, says the *Lancet* of Aug. 9. Speaking of pneumonia, he declared his disbelief in the cause of the disease being either Friedländer's bacillus or the diplococcus of Fraenkel and Weichselbaum. Inoculation of this latter microbe, he remarked, is said to procure immunity from subsequent inoculations, which is exactly contrary to the effect of an attack of pneumonia, for it rather predisposes the subject to subsequent attacks. Again, M. Crocq injected sputum from pneumonic patients in which the diplococcus had been found, into the lungs of four rabbits, but none of them contracted pneumonia. Lastly, in a doubtful hospital case the sputum was examined, and found to contain the diplococcus, but at the post-mortem examination no pneumonia was discovered. M. Crocq has never met with any cases of contagion in pneumonia, and Finckler's cases he considers were not pneumonia at all. Moreover, Fraenkel's microbe is found in affections which are neither pneumonia nor contagious. The mortality usually reported by other observers in pneumonia varies greatly; that is to say, from 5 to 35 per cent. M. Crocq has no mortality at all. He arrests all his pneumonia cases by bleeding. Rheumatic fever, and even puerperal metro-peritonitis, he treats in the same way. The latter, he declared (amidst tokens of dissent) can be thus cured in the great majority of cases. "Never," he went on, "have I regretted having bled a patient, though I have often been sorry that I have abstained from doing so. . . . If I were to be forbidden to bleed, I would give up the practice of medicine." He was, of course, careful to explain that blood-letting, to be of any service, must be practised intelligently, and not abused, as he fears it may again come to be after the wave of reaction has once more made it popular.

LETTERS TO THE EDITOR.

* * * Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Professor Hazen and Espy's Experiments.

A CORRESPONDENT has recently called my attention to certain communications of Professor Hazen to *Science* and the *American Meteorological Journal*, in which Espy's experiments are assailed, and thus indirectly my theory of cyclones and tornadoes, and he thinks there should be a reply to them. A reply, so far as they bear upon my theory, if thought necessary, is very easy; so easy, indeed, that I had not thought it necessary. Besides, I have been desirous of avoiding an unprofitable controversy with Professor Hazen on this subject.

Inasmuch as I have never used any of the results of Espy's experiments, any attack upon these experiments does not reach me, except so far as it may bear upon the results of other great physical experimenters. It is true, I sometimes refer to this noted pioneer in meteorological advancement, as any one in this age may still refer to Kepler and Newton, and very properly, but it is not at all necessary. The formula which I have used throughout in my researches, as the basis of the physical part of my theory,

and which completely covers the ground of Espy's experiments, is one given by Dr. Hann in a paper published in the *Zeitschrift* of the Austrian Meteorological Society for 1874, and translated by Professor Abbe, and republished in the "Smithsonian Report for 1877." This formula, in a somewhat different form, originated with Sir William Thomson, and has been used, and gradually brought to its present form, by Dr. Reye, Peslin, Clausius, Hann, etc., and so rests upon high authority. The physical constants in this formula have been determined by renowned experimenting physicists. They are the mechanical equivalent of a unit of heat, the specific heat of air, the latent heat of aqueous vapor, the tension of the aqueous vapor of saturated air at any given temperature, etc. From this formula have been computed the rate with which ascending dry air decreases in temperature with increase of altitude, which is 0.99° for each hundred metres, and also the same for ascending saturated air at given temperatures and altitudes. These latter are given in Table III. of the appendix of my "Popular Treatise on the Winds," etc., and range from 0.37° for a high temperature at the earth's surface, up to 0.74° for a temperature of -10° C., the values for all temperatures decreasing with increase of altitude. With these data I have illustrated, by means of the table on p. 232 of the work referred to above, how the temperature in ascending currents decreases with increase of altitude under different assumed conditions, and have shown that it is very much greater than it would be in the case of dry air, and also greater than that of the surrounding air when the lower strata become a little more warmed up than usual in comparison with the upper strata. All these results have been deduced from a formula resting upon the high authorities already mentioned, and having had its origin with Sir William Thomson less than thirty years ago. Yet Professor Hazen makes the astonishing assertion that nothing has been done since Espy's time, more than fifty years ago, and that "the profoundest calculations and speculations upon the development of energy in the free air are based upon a few experiments of the crudest sort made in a small jar."

The latent heat of aqueous vapor in the formula referred to, as determined by Regnault, may be expressed for ordinary temperatures by $r=607-708t$; but according to Hazen it should be $r=0$, for he maintains that there is no latent heat set free in condensation. With $r=0$ in the formula, instead of the numbers in the table referred to above, ranging at the earth's surface from 0.37° to 0.74° , and being still less at high altitudes, we should have for all temperatures and altitudes 0.99° ; that is, the rate of decrease of temperature in all cases would be that of ascending dry air, and of course the energy upon which the cyclone or tornado depends would be much diminished. Now, if Regnault has made so great a blunder, and a cloud is thrown over his reputation by Hazen's experiments, it is for the experimenting physicists of the day to take up the matter, and not for me; for I am not an experimenter, and, if I have erred, it is in relying upon insufficient authority.

It has never been claimed, even by Espy himself, that his experiments were of a refined and accurate character, and that his results were any more than rough approximations. They have been regarded as important first steps only. Espy says, "I would not wish to be understood here as saying by implication that the numbers used in this paper are strictly correct. These numbers are introduced chiefly for the purpose of illustrating the theory." He again says with regard to his results, "The grand object, then, for which these experiments were instituted, is established beyond doubt,—that the latent caloric of vapor causes the air to occupy much more space when it is imparted to the air than when it is united with water in the form of vapor." The same is shown by Dr. Hann's formula, but the latter gives quantitative results. Espy inferred from his experiments that when dry air ascends it becomes colder about 1.25° for every hundred yards of ascent. The true amount is 1.6° . He also inferred, that, when air ascends from the earth, it will begin to form cloud when it rises about as many times one hundred yards as the temperature of the air is above the dew-point in degrees of Fahrenheit. The true number is seventy-six yards.

There is a great error in several of Hazen's papers with regard

to the amount of heat arising from compressing the air, which may be noticed here. He says (*Science*, June 27) that if air is compressed 10 inches, that is, from a barometric pressure of 30 inches to 40 inches, the temperature is increased 163°. The formula for computing this, as given by Poisson, is

$$\frac{T'}{T} = \left(\frac{p}{p'}\right)^{0.291},$$

in which T and T' are the temperatures corresponding to p and p' respectively. If we put $T' = 490^\circ$, and $p' = 30$ inches, this formula gives, for $p = 40$ inches, $T = 490^\circ = 43^\circ$ instead of 163° as stated above. Hazen, by his method of experimenting, was able to get a heating of the whole jar of only 4° in compressing to 10 inches, or one-third of an atmosphere. This, he says, is only about one-fortieth of the theoretical value; but it is not so much in error as that, for it is about the eleventh part of the theoretical value. But Espy, in compressing to 10 inches, obtained 36° as indicated by the rise in the gauge after explosion. The theoretical value in this case given by Poisson's formula, the temperature at which Espy operated being 64° , is 45° . This, unless Poisson's formula is erroneous, indicates that the method of getting the amount of heating from the amount of rise in the gauge after explosion, is much more accurate than that of Hazen's.

WM. FERREL.

Martinsburg, W. Va., Sept. 24.

BOOK-REVIEWS.

Belief in God; its Origin, Nature, and Basis. By J. G. SCHURMAN. New York, Scribner. 16°. \$1.25.

THIS book consists of a series of lectures delivered at the Andover Theological Seminary during the present year. The author's object is partly to justify the belief in God, and partly to set forth his own conception of what God is. In discussing the grounds of our belief in the Divine Existence, Professor Schurman makes some excellent points against the agnostics, but fails to present any new or conclusive argument of his own. Indeed, he admits that in his view the existence of God cannot be demonstrated, but holds it to be a necessary assumption to account for the universe. He gives a brief but philosophical sketch of the history of religion, which forms the best chapter in the book. When, however, he comes to state his own view of the nature of God, he takes a position that few theists will be inclined to adopt. His doctrine is an extreme pantheism, essentially the same as that of Spinoza,—a doctrine that denies all reality to finite things, and maintains that they are only modes or functions of God. He says, "Nothing remains for us, therefore, but to surrender the vulgar belief in the existence of a multiplicity of independent things. There is but one real being; and of it A and B and all existing things must be conceived as parts, moments, or functions" (p. 166). If this theory is true, it is obvious that there is no room left for human personality; and Professor Schurman's attempt to save personality can only be characterized as sophistical. We are obliged to add that some parts of the book are too dogmatic for a philosophical work, being characterized by sweeping assertions of which no proof is given or even attempted. On the whole, we cannot see that Professor Schurman has helped us any toward solving the problem of theism.

AMONG THE PUBLISHERS.

"THE Story of a Magazine," a most interesting story of the conception and growth of *The Ladies' Home Journal* of Philadelphia, with portraits and sketches of its proprietor and editor, has been prepared by that magazine in pamphlet form, and will be sent free to any who will write for a copy.

—Civilization; an Historical Review of its Elements," in two volumes, will soon be issued by S. C. Griggs & Co., Chicago. The author is Charles Morris of Philadelphia. This work promises to diverge from the course usually pursued by historians on this subject. It seeks to set forth, in clear and simple language, the evolutionary steps by which the human race has passed upward from primitive savagery to modern enlightenment, and in this way to discover the true philosophy of human progress. With this end in view, the topical method is adopted, and the facts of

history are used to illustrate and embellish, rather than to form the ground-work of the structure.

—*Harper's Weekly* of Oct. 4 devotes four full pages—two of text and two of illustrations—to the recent Mississippi River improvements.

—Andrew Lang is the subject of the engraved portrait in the *October Book Buyer*. The sketch gives an idea of the personality of the man as well as of his career as an author. Rudyard Kipling, whose portrait appears also in this number, is described in an article from which one can learn a good deal about this new and brilliant writer and his books.

—Professor Darwin of Cambridge, England, a son of the world-renowned Darwin, contributes to *The Century* for October a paper of high and original value on "Meteorites and the History of Stellar Systems." A striking photograph of a nebula, in which a system like our own solar system seems to be in actual formation, accompanies this paper. "Prehistoric Cave-Dwellings" is an illustrated paper by F. T. Bickford, on the prehistoric and ruined pueblo structures in Chaco Cañon (New Mexico), the Cañon de Chelly (Arizona),—the ancient home of the most flourishing community of cave-dwellers,—and other extraordinary cave villages.

—Mr. G. J. Smith has prepared "A Synopsis of English and American Literature," which issues from the press of Ginn & Co. of Boston. It gives first a list of English authors, with the names of their principal works, and accompanied by a chronological view of contemporary history. This is followed by a list of American authors, arranged on a similar plan. The work is in no sense a history, but a mere tabular list, but as such it has some merits. Its principal fault is the exaggerated importance attached to American literature, which is accorded nearly as much space as that of England. The authors in both tables are arranged as far as possible in classes, according to the kind of literature they produced, and reference is further facilitated by two indexes.

—*Babyhood* for October contains an article on the "Common Disorders of Teething Time," which the writer, Dr. John Dorning, contends are in most cases not related to the process of teething. He exposes very strikingly some of the fallacies entertained on this subject, while giving useful hints to the mothers of teething infants. "Massage," by Dr. Sarah E. Post, is probably the first popular article that has appeared on this subject, which is attracting increased attention, especially in connection with certain disorders of infancy. The article is illustrated, and gives directions as to the various kneading motions.

—An article in *Lippincott's Magazine* for October upon "Electric Lighting," by the English scientist Sir David Salomons, will find many readers; for, though electric light has come into such general use, it is but little understood by the general public. The article treats also of electric motive power, which is as little understood as electric lighting. A thoughtful paper upon "University Extension" is from the pen of Professor Skidmore. He advocates the idea of broadening the scope of the university so that the educational advantages it affords may be extended to the masses, and holds that schools should be brought into parallelism with life, instead of serving as introductions to it. In "Book Talk," Julian Hawthorne has an essay upon Rudyard Kipling.

—"Health for Little Folks" is the title of No. 1 of the *Authorized Physiological Series*, just published by the American Book Company. The book is intended for use in primary schools. The method and language are such as to make the matter easily comprehended by the young people for whom it is intended. Some may ask why the subject of physiology is introduced at all in the course of study of the primary schools, and the answer is to be found in the desire of the total abstainers to inculcate their ideas about alcohol in the minds of all pupils of the public schools; and, as many a child does not pursue his schooling far, it is necessary for their purpose that the doctrine that alcohol is a poison should be inculcated while the schools still have possession of the pupil.

—A popular work on the literature of India, entitled "Hindu Literature, or The Ancient Books of India," by Mrs. Elizabeth A. Reed, will soon be issued by S. C. Griggs & Co., Chicago. This volume treats of Hindoo literature from the earliest songs of the

Aryan race to the writings of mediæval days. The author reviews the labors of Sanscrit scholars in this vast field of literature, and then gives a survey of the great Indian epics, whose character and scope are illustrated by copious extracts. Her work has elicited the cordial interest of such authorities as Professor Max Müller and Sir Monier Williams, professor of Sanscrit in Oxford University; and the latter has done her the high honor of revising the chapter on "Krishna."

—Messrs. E. & F. N. Spon announce as nearly ready, "Mining and Ore Dressing Machinery," by C. G. Warnford Lock, being a comprehensive treatise dealing with the modern practice of winning both metalliferous and non metalliferous minerals, including all the operations incidental thereto, and preparing the product for the market; and as just published "Waterways and Water Transport in Different Countries, with a Description of the Panama, Suez, Manchester, Nicaraguan, and other Canals," by J. Stephen Jeans. The purpose of this latter volume is to deal with water-transport only, and more particularly that part of water-transport which is carried on by means of artificial waterways. A good deal of attention has been given in this work to the subject of isthmian canals; and in the appendix will be found a large mass of information as to the extent of the British canal system, and the dates at which the principal canal and river navigations were executed.

—The following announcement by the D. Van Nostrand Company is made regarding their Science Series. No. 9 of the series, "Fuel," by C. William Siemens, is now out of print, but it is to be entirely rewritten and very much enlarged by Mr. Arthur V. Abbott. The additional matter will take up the subject of gas and petroleum as fuel; while the chapter on artificial fuel, by John Wornald, will be retained, with some new matter. Tables will be added, so as to increase the value of the work to students in general. The title of the new edition of No. 57, which will be

ready soon, will be "Incandescent Electric Lighting: A Practical Description of the Edison System, by L. H. Latimer, to which is added the Design and Operation of Incandescent Stations by C. J. Field, and a Paper on the Maximum Efficiency of Incandescent Lamps by John W. Howell." The same firm have in preparation a translation of Dr. Otto Dziobek's "Mathematical Theories of the Motion of the Planets."

—The *Quarterly Journal of Economics*, published for Harvard University by George H. Ellis, Boston, begins its fifth volume with the number for October. The number will contain papers by Professor A. G. Warner of Nebraska, on "Some Experiments in Behalf of the Unemployed," describing interesting experiments in the United States, Germany, and Holland; by Professor S. M. Macvane of Harvard University, on "The Discussion of Value and Wages in the Recent Great Work of Boehm-Bawerk, the Austrian economist;" by Chauncey Smith, of the Boston bar, on "A Century of Patent Law," an account of the patent law of the United States and of its working during the last hundred years; and by Henry Hudson, on "The Southern Railway and Steamship Association." In addition, there will be the usual list of recent publications on economics, and general notes and memoranda, among which is a description, by Herr Stephan Bauer of Vienna, of recent discoveries by him of unpublished material on the French economists.

—Messrs. Funk & Wagnalls send us two numbers of their series of "American Reformers." The first is a life of "Wendell Phillips the Agitator," by Carlos Martyn, and is not a good beginning of the series. It gives, indeed, a large amount of information not only about Phillips himself, but also about the anti-slavery agitation and other movements in which he was engaged, and contains many extracts from his speeches. But the author's style is full of "gush" and magniloquent expressions, such as would have been displeasing to Phillips himself, and will be equally so to every

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Frog Farming.
Some Thoughts on Light.
Cysticercoids Parasitic in *Cypripedium*.
Some remarks on the Pucciniae attacking Galium.
The Influenza Bacillus.
Mounting Medium for Vegetable Structures.
The Study of Entomology.
A Homely Zoophyte Trough.
Beetles.
Dips into my Aquarium.
Artificial Sea-Water.
Among the Sea-Urchins.
Food from Wood.
The Elements of Microscopy.
The Aspect of the Heavens.
In Darkest Africa.
Selected Notes from the Society's Note Books. (80 pages in this part.)
Coccus cataphractus.
Gomphonema Germinatum.
Fronds of Ferns.
Cuticle Stangeria paradoxa.
Stangeria paradoxa.
Tracheæ of Insects.
Unopened Eye-lids of Kitten.
Section of Piper.
Law of Mole.
Reviews. Title. Preface. Index.

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cultivated reader. The other book, "Horace Greeley the Editor," by Francis Nicoll Zabriskie, is a better work. The author, in our opinion, has too high an estimation of his hero, yet he exposes Greeley's faults, and perhaps says a little too much about his eccentricities. On the whole, though it bears, like Mr. Martyn's work, the marks of too great haste in writing, it will serve a purpose as a popular biography of Greeley. Let us hope, however, that the authors of the remaining books of the series will all use a sober and simple style, with careful avoidance of rhetoric.

— "English Sanitary Institutions, Reviewed in their Course of Development, and in Some of their Political and Social Relations," is the title of a volume by Sir John Simon, K.C.B., which the Cassell Publishing Company announce. The book is the result of some twenty-eight years' experience and of various official relations to the business of sanitary government. The author has written for the lay as well as the professional reader, and has as far as possible avoided technicality in the expression of his views.

— The contributors to the October *Magazine of American History* present a rare combination of eminence in the scholarly world. The number opens with a paper on the "Sources and Guarantees of National Progress," by Rev. Dr. R. S. Storrs of Brooklyn. This is prefaced by a portrait of the distinguished author, and, occupying twenty-eight of the pages of this periodical, is from first to last a procession of brilliant passages, clear, forcible, suggestive, showing what principles developed the little settlements into a great nation, whose future history is as secure as the past if only that moral life remains which characterized the founders of empire on this continent. The second paper, entitled

"The American Flag and John Paul Jones," is from the pen of Professor Theodore W. Dwight of the Columbia Law School, New York. "Southold and her Homes and Memories," one of Mrs. Lamb's entertaining articles, is illustrated with antique dwellings of one of the oldest towns on the continent. "The Historic Temple at New Windsor, 1783," together with a curious picture recently discovered, comes from the well-known jurist, Hon. J. O. Dykman. "About Some Public Characters in 1786," we have a readable group of extracts from the private diary of Sir Frederick Haldimand. The "General Characteristics of the French Canadian Peasantry," by Dr. Prosper Bender, furnishes much interesting data on a theme of present interest. "The Mountains and Mountaineers of Craddock's Fiction," by Milton T. Adkins; "Anecdotes of Gen. Grenville M. Dodge," by Hon. Charles Aldrich; "The Story of Roger Williams retold," by H. E. Banning; "Antiquarian Riches of Tennessee;" and the several departments of miscellany,—follow. This magazine is in close sympathy with current affairs.

— Mr. T. Wemyss Reid, the biographer of the Right Hon. W. E. Forster, has performed an equally friendly office for the late Richard Monck-Milnes (Lord Houghton). "The Life, Letters, and Friendships" of this poet will form the subject of two volumes which the Cassell Publishing Company have now in press.

— The Johns Hopkins University has issued a pamphlet on "The Study of History in Holland and Belgium," by Paul Frédéricq, translated from the French by Henrietta Leonard. The same author had previously described the methods of historical teaching in England, France, and Germany, and he here endeavors to apply

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what he learned in those countries to the improvement of historical teaching in his own neighborhood. The historical courses at both the Dutch and the Belgian universities are characterized as quite meagre, the subject not having been accorded due prominence by the authorities. The teaching is mainly what M. Frédéricq calls theoretical, the object being to impart historical information without any attempt at original investigation. M. Frédéricq has perhaps too low an opinion of such teaching, and lays almost the whole stress of his remarks on the need of practical

courses for the study of history in its sources. Some of the Belgian professors, including the author himself, have established volunteer courses of this kind; but something more effective and permanent is, in his opinion, necessary to place the study on a satisfactory basis. In Holland the state of things seems to be rather worse than in Belgium, though at the University of Amsterdam there is an important course in political geography, under the guidance of M. Kan, which extends over a period of three years.

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HYBRIDS.—A. M. Suchetet, 10 Rue Alain, Rouen, France, desires to correspond with those possessing hybrids, either living specimens or stuffed, of mammals, birds or other animals.

CHEMIST.—A Harvard Graduate and Specialist in Chemistry desires a position with some manufacturing industry, or with a practical chemist. He would make an engagement to take charge of a laboratory and lecture on Chemistry. He has had large experience in the laboratory and school-room, and can give the best of references. Address J., Harvard College, Cambridge, Mass.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

For exchange—Nice specimens of *Unios alatus*, *trigonus*, *paivus*, *occidens*, *anadontoides gibbosus*, *rectus*, *verucosus*, *gracilis coccineus*, *ventricatus*, *multiplicatus* and *plicatus cornutus*. *Margaritana confrosgosa*, *complanata*, *rugosa*. *Anadonta edentula*, *decora*, *corpulenta*, and about 300 of the beautiful *Ana suborbiculata*. Wanted: *Unios* from all parts of the world, and sea-shells. Address Dr. W. S. Strode, Bernadotte, Ill.

For exchange—minerals and fossils, including ores, corals, Mazon Creek nodules for other minerals and fossils or historical relics. Tertiary specimens desirable. Address T. N. Glover, Lock Box 19, Suffern, N. Y.

I wish to exchange Riley's Missouri Reports, either singly or full set, for Proceedings Entomological Society, Philadelphia, vols. 2 to 6 inclusive. Will also exchange Casey's Revision of the *Stenini* of N. A. and Horn's Revision of the *Tenebrionidae*. F. M. Webster, Lafayette, Ind.

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CALENDAR OF SOCIETIES.

Natural Science Association of Staten Island.

Sept. 11.—Charles W. Leng, Additions to Local Lists of Coleoptera; Joseph C. Thompson, Eggs of the Snapping-Turtle; H. Baruth presented a large block of sandstone containing casts of spirifers.

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